PHYSICS 12 MAGNETIC INDUCTION WORKSHEET 2

1. A single loop of copper wire in the shape of a square 4.0 cm on each side is lying flat on a horizontal table. A large electromagnet is positioned with its north pole directly above so that the uniform magnetic field is vertically downward onto the loop.
   a) Compute the average induced EMF across the loop as the field varies linearly from 0 to its final value of 0.50 T in 0.20 s.
   b) What is the direction of the induced current?

2. A coil of wire, of 20 turns and area 0.040 m^2, is rotating uniformly at 10 Hz about an axis in the plane of the coil and perpendicular to a uniform field of 0.30 T. What is the average EMF induced in the field? This is equal to the average EMF for 1/4 turn.

3. A transformer which has 1800 turns on the primary and 270 turns on the secondary has an input voltage of 120 V, an output current of 9.4 A and an efficiency of 100%.
   a) What is the output voltage? b) What is the input current?

4. A transformer designed to change 16 V to 2400 V has 5 turns on the primary winding. How many turns must it have on the secondary winding, if it is 100% efficient?

5. A transformer with a 98% efficiency causes a primary voltage of 240 V to step down to 12.0 V. If the secondary current is 20.0 A, what is the primary current?

6. A town receives 1.0×10^7 W of power delivered at 5.0×10^4 V from a generator over power lines that have a resistance of 5.0 Ω. What percentage of the power generated is lost as heat in the lines?

7. The power input to transmission lines is 14 500 W. If the input voltage is doubled without changing the input power, by what factor will power loss in the lines be multiplied?

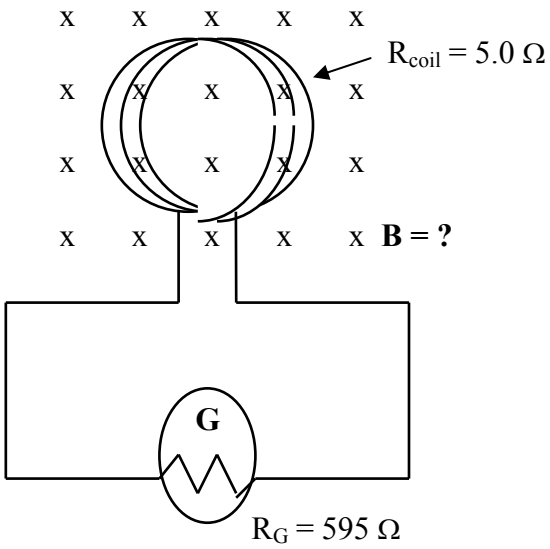
8. The armature of a DC motor has a resistance of 5.0 Ω. The motor is connected to a 120 V line, and when the motor reaches full speed the back EMF is 108 V.
   a) What is the current at "start-up" (<u>before</u> the motor turns over)?
   b) What is the current when the motor is being used?

9. The armature of a 120 V DC motor has a resistance of 6.4 Ω. When the motor reaches full speed the current through it is 2.5 A.
   a) Calculate the current when the motor starts.
   b) Calculate the back emf when the motor is running at full speed.

10. A voltage of 12 V is applied to an electric motor with an armature resistance of 5.0 Ω. At peak rotation, the current in it is 0.48 A. When a load is placed on the motor, its speed (and therefore its frequency) is reduced to 1/3 of its peak speed. What is the back emf of the motor under this load?

11. A DC motor is connected to a 120 V source. The motor's coils have a resistance of 4.6 ohms. At full speed the current through the motor is 1.5 A. Calculate the power lost by the motor to heat when
    a) the motor stalls or jams.
    b) the motor is operating at normal speed.
    c) Determine the back EMF when the motor is operating normally.

12. A 5.0 Ω coil of 100 turns and 3.0 x 10^{-2} m radius is placed between the poles of an electromagnet and perpendicular to the flux. When the coil is suddenly removed from the field of the electromagnet, a charge of 10^{-4} C is sent through a 595 Ω galvanometer connected to the coil. Compute the magnetic field **B** between the poles of the electromagnet. (Hint: combine formulas and see what cancels)



1. a) 4.0 x 10^{-3} V b) ccw 2. 9.6 V 3. a) 18 V b) 1.4 A 4. 750 5. 1.02 A 6. 2.0% 7. 1/4 8. a) 24 A b) 2.4 A
9. a) 19 A b) 104 V 10. 3.2 V 11. a) 3.1 x 10^{3} W b) 10 W c) 1.1 x 10^{2} V 12. 0.21 T